MEMORANDUM

SUBJECT: Interpretation of Cementing Requirements in 40 CFR 146.65 for Class I Injection Wells

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TO: Larry D. Wright, Chief
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With this memorandum, we are providing you with a clarification of EPA Headquarters' interpretation of the construction requirements for Class I injection wells referenced in the Underground Injection Control (UIC) regulations (§146.65). This clarification is particularly timely in light of a state program revision submitted by the Texas Commission for Environmental Quality (TCEQ) (formerly the Texas Natural Resource Conservation Commission) for classes of injection wells which they regulate.

Paramount to EPA's determination to approve or disapprove TCEQ's submission was a finding as to whether or not the state's casing and cementing standards for Class I injection wells meet minimum federal requirements. The TCEQ's Class I well cementing regulations were included as part of the state's UIC program revision package.

We believe that the federal regulatory language, as currently written, does allow for some flexibility in the interpretation of requirements for alternative methods of cementing under 40 CFR 146.65(c)(4), particularly the requirement that cement be "continuous." This is consistent with the preamble language which states that these regulations were developed to "provide a level of protection appropriate to wells injecting hazardous waste, yet one which is *not unnecessarily burdensome* (emphasis added). 53 Fed. Reg. 28118, 28131 (July 26, 1988). In addition, the preamble states that the 1988 construction requirement amendments "reflect the Agency's attempt to achieve an appropriate balance between specific design standards and more general performance standards." *Id.* at 28136.

Section 146.65(a) establishes minimum construction requirements for Class I hazardous waste wells in terms of basic performance standards. One of these standards is to "prevent the movement of fluids into or between USDWs or into any unauthorized zones." Section 146.65(c) establishes additional minimum design standards for new wells which require that:

(1) the casing and cement used in the construction of each new well "be designed to prevent the movement of fluids into or between USDWs, and to prevent potential leaks of fluids from the well."
(2) at least one surface casing string shall "extend into the confining bed below the lowest formation that contains a USDW and be cemented by circulating cement from the base of the casing to the surface, using a minimum of 120% the calculated annual volume."
(3) "at least one long string casing, using a sufficient number of centralizers, shall extend to the injection zone and shall be cemented by circulating cement to the surface in one or more stages."

Neither §146.65(c)(2) nor (3) expressly requires the circulation of cement to be continuous and §146.65(c)(4) states that the circulation of cement may be accomplished by staging. However, §146.65(c)(4) also allows alternative methods of cementing in cases where the cement cannot be recirculated to the surface provided that the owner or operator can demonstrate by logs that the "cement is continuous and does not allow fluid movement behind the well bore." Thus, the only situation in which "continuous cement" is a relevant criterion is where alternative methods of cementing are being used as specified in §146.65(c)(4).

While §146.65(c)(4) uses the expression "cement is continuous" in reference to alternative methods to stages, the technical limitations of the very measurement devices specified by the rule require a conclusion that the term "continuous" not be taken literally. For approval of an "alternative method," the regulations specify that logs must demonstrate that the cement is continuous. While geophysical logging tools are the current state-of-the-art method for the determination of the presence of cement behind casing, fluid flow in the well bore, and other well construction parameters, they are, in themselves, not a direct measurement. They are, in practice, a sophisticated form of remote sensing capable of providing adequate information required by the regulations to assure that proper well construction has been met. Well logs do not necessarily provide an inch-by-inch assessment of well bore construction. Both the physical construction and the configuration of the electronics in these logging instruments provide *averaged* results. The hard print-out of results are displayed as a *scaled* assessment (e.g. typically 1 inch or 5 inches on a log represents 100 feet) of well bore parameters.

Thus, because we rely solely on logging tools in order to validate the presence or absence of cement,"continuous cement" cannot literally mean that the cement can have no breaks at all from the bottom to the top of the well. Currently available cement logging tools are not capable of providing that fine a level of precision to indicate that every conceivable void, crack, pore or gap has been totally filled in with cement. Instead, we believe the "continuous cement" criterion, as used for purposes of approving "alternative methods," is satisfied when enough cement is present so that logs indicate that there are no measurable breaks in the cement sheath, or, if measurable, that those breaks do not compromise the performance standard of precluding fluid movement along the well bore. As long as there is adequate cement to achieve this performance standard, we interpret that the cement is continuous.

Alternative methods in (c)(4) only come into play when the basic methods in (c)(2) and (3)-- which do not require "continuous cement"-- are not feasible. It would be illogical to require a stricter "continuous cement standard" when using an "alternative method" than when using the basic methods. One standard industry practice used when conducting stage cementing under (c)(3) and (4) does not typically allow for continuous cement throughout the well bore. Rather the practice estimates the cement volume so that the top of the cement will be as close to the next stage collar as possible. This is accomplished utilizing a caliper log and information from nearby wells. While the driller will calculate the volume of cement for each stage to get the top of the cement as close to the upper stage collar as possible, it is not prudent to pump too much cement because this could result in covering the overlying stage portal. Then, the next stage collar would be blocked and the next stage of cement could not be pumped. Thus, not all drillers automatically add excess cement to the calculated volume; any additions would be based on the cementing history of nearby wells and the porosity of the zones to be isolated. However, EPA also acknowledges that some drillers, in practice, do add additional cement over calculated volumes when staging, and will also factor in cement setting times to allow for a more thorough cementing procedure.

But rather than interpret the term literally, we maintain the position that the reference to "continuous" cement in §146.65(c)(4) should be interpreted according to the purpose it is supposed to accomplish. In this context, the purpose of continuous cement is to provide a sufficiently stable base upon which to do additional staging and to prevent the movement of fluids into or between underground sources of drinking water (USDWs) or into any unauthorized zones as required by the performance standard defined in §146.65(a). Geophysical logs reveal that in some actual operating wells, a continuous sheath of cement from bottom to top is not a necessary condition for preventing fluid movement behind the casing and may even result in a lower quality cement job than alternatives. Therefore, since using continuous cement from bottom to top does not mean that a well is more protective than if it was constructed not using continuous cement, it would not be reasonable or make sense to interpret (c)(4) as requiring bottom to top continuous cement under all alternative method scenarios.

Additionally, the preamble to the final rule, (53 Fed. Reg. 28118, 28137 (July 26, 1988)), clearly indicates that bottom to top continuous cement is not required in all cases in order for the well to meet the construction requirements in 40 CFR 146.65. The preamble refers to the practice in the Arctic where the section of the annulus through the permafrost must be filled with a nonfreezing fluid to prevent collapse of the long string casing. The preamble recognizes that this situation obviously precludes using continuous cement and observes that the Director is given discretion in approving such alternative cementing programs under both §§144.16 and 146.65.

The revised Texas regulations specifically adopts the performance standard in §146.65(a). Although the regulation does not mention the requirement of "circulating cement" as does the Federal counterpart in §146.65(c)(2) and (3), it does require that the amount of cement be at a minimum 120% of the calculated annular volume and allows cementing by staging. The Texas regulation parallels §146.65(c)(4) by allowing an approved alternative method of cementing in cases where the cement cannot be recirculated; however it does not mention that the cement must be continuous. Thus, whether the Texas regulation meets the federal requirements is primarily contingent upon our interpretation of "continuous cement " in §146.65 (c)(4), in addition to the probable need for TCEQ assurances.

Based on our interpretation of the use of the term "continuous cement", our findings regarding well cementing technology and industry practices, and the implementation of the cementing regulations for injection wells in both direct implementation programs administered by the EPA regions and the primacy programs in the states, we would accept the Class I UIC cementing regulations referenced in the TCEQ program revision as meeting the requirements of the federal UIC regulations as required by 42 USC 300h-1(b)(1)(A)(I).

If you have any concerns, please contact me or Bruce Kobelski, UIC Program Management Team Leader, at (202) 564-3888.